

A NEW SUBSPECIES OF *NEONYMPHA MITCHELLII* (FRENCH) (SATYRIDAE) FROM NORTH CAROLINA

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ABSTRACT. In 1983, a colony of *Neonympha mitchellii* was discovered in south central North Carolina. Before 1983, *mitchellii* was known only from Michigan, Indiana, Ohio, and New Jersey. The newly discovered population co-occurs with *Neonympha areolatus* (J. B. Smith). Comparison of 60 male genitalia of *mitchellii* from Michigan and New Jersey and 20 from North Carolina with 60 of *areolatus* showed that the two have distinct valvae and are separate species. Comparison of 200 Michigan and New Jersey *mitchellii* with 47 North Carolina *mitchellii* revealed several population differences. The North Carolina population is here named *N. m. francisci*. Both nominate and new subspecies are in need of conservation.

Additional key words: *Neonympha mitchellii francisci*, systematics, biology, endangered, habitat.

Neonympha mitchellii French (1889) is one of the most restricted butterflies in the eastern U.S. Its known range before 1983 was Michigan, Indiana, Ohio, and New Jersey (Opler & Krizek 1984). On 2 June 1983, Kral discovered a small colony of *mitchellii* on Fort Bragg Military Reservation, Fort Bragg, North Carolina. This discovery was both a new State record and a significant extension of known range.

There has been confusion as to whether *Neonympha mitchellii* and *N. areolatus* are distinct species (Scott 1986, Mather 1965). Wing maculation characters are not always reliable. There are several populations in North Carolina where some *N. areolatus* have round hindwing ocelli much like typical *N. mitchellii*. Such a population is adjacent to the habitat of the North Carolina *N. mitchellii* population, and there are similar phenotypes in other *N. areolatus* populations such as in Gates Co., North Carolina. The problem of identification is obviously greatest where the ranges of the two species overlap. This confusion is resolved here by genitalic structure. Male genitalia of 60 nominate *mitchellii* from Michigan and New Jersey and 20 from North Carolina were compared with 60 of *areolatus*, with results as follows. The distal process of the *areolatus* valva has a distal toothlike process that projects sharply dorsad, while that of *mitchellii* has a distal process that projects laterad and is denticulate (Fig. 1).

Comparison of North Carolina *mitchellii* with Michigan and New Jersey *mitchellii* revealed several population differences (Table 1). Be-

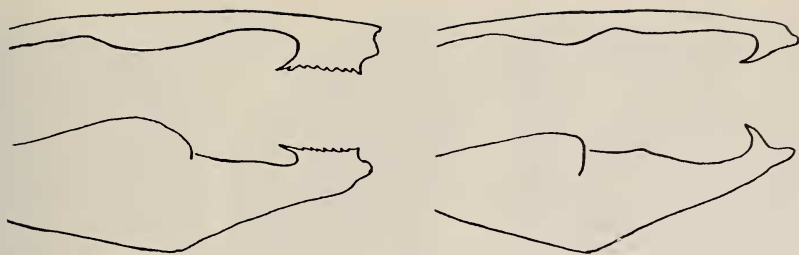


FIG. 1. Top left and right lateral views of *Neonympha* male valvae. Left, *N. mitchellii*, Jackson Co., Michigan; right, *N. areolatus*, Fort Bragg, North Carolina.

low we describe and name the North Carolina population. Parenthetical color names are based on Ridgeway (1886).

***Neonympha mitchellii francisci* Parshall & Kral, new subspecies**
(Fig. 2, Table 1)

Description (male holotype). Left forewing length 17.0 mm (for all males, mean 16.7 mm, range 15.0–18.0 mm, N = 35). Dorsal wing surfaces uniform chocolate-brown (vandyke brown) except for apex and outer margins. Outer margins and forewing apex have modified hairlike scales slightly lighter brown than rest of dorsal surfaces, resulting in lighter brown fringe along outer margins, and much wider (1 mm) band of light-brown buff scales (drab brown) forming a second submarginal band which follows contour of forewing margin. Second submarginal band lighter brown than fringe scales or rest of ground scales of dorsal wing surfaces. A line of dark brown scales identical to first completes submarginal bands. Dorsal submarginal bands viewed together are widest on hindwing surfaces, forming uniform width of nearly 2 mm. Hindwing inner margin covered with light brown scales from inner margin vein 2A to submarginal band at anal angle. It then flows basally, completing the triangular light brown area. Rest of dorsal surface uniformly unmarked.

Ventral surfaces of both wings light brown, lighter than dorsal surfaces but not as light as ventral surfaces in nominate *N. mitchellii*. Fringes of apex and outer margin much darker than dorsal surfaces, slightly contrasting to lighter ground color of these surfaces. Outer marginal fringe followed by a rufous (ochraceous-rufous) submarginal band. This band, 0.75 mm wide, begins along costal margin, closely following contour of outer margin, ending at inner margin. Proximad to this band is a very thin submarginal line of dark brown scales which follows entire length of much wider rufous band. A second less rufous band follows lighter band. Second proximad rufous band is thinner than first and follows outer margin contour beginning subapically at vein R_5 and ending at inner margin. Three submarginal bands together are ca. 1.5 mm wide.

Forewing postmedial area has row of 4 ocelli in cells M_1 , M_2 , M_3 , and Cu_1 . Ocelli in M_2 and M_3 largest and most developed. Ocellus of cell M_1 only faintly present. All 4 ocelli have silvered pupils which are a series of flat, clear scales with silver sheen. Each 3 fully developed ocelli have a thin ring of yellow buff scales with interior ground of black with silver pupils. Ocellus in cell M_3 is largest.

Forewing with 2 medial transverse bands, 1 barely extracellular, the other transcellular, both darker brown than rufous. Extracellular transverse band begins subapically at vein R_4 and meets 2nd submarginal band to form continuous band. Extracellular band then flows diagonally to vein M_1 , ca. 2 mm from junction of M_1 and discal cell, ending vertically at inner margin at vein 2A. This medial line forms closure around postmedial row of ocelli open at inner margin. Second or transcellular line parallels path of first, ending

TABLE 1. Comparison of *Neonympha mitchellii* subspecies.

Character	<i>m. francisci</i> (North Carolina)		<i>m. mitchellii</i> (Michigan & New Jersey)	
	Male	Female	Male	Female
Left forewing length				
Mean \pm SD	16.7 \pm 0.8	18.8 \pm 0.8	16.4 \pm 0.75	18.3 \pm 0.5
Range	15.0–18.0	17.5–20.1	16.0–19.0	18.0–24.0
N	35	12	44	31
No. forewing ocelli				
Mean \pm SD	3.3 \pm 0.7	4.0 \pm 0.65	3.7 \pm 0.5	5.9 \pm 0.7
Range	2–5	3–5	2–4	5–6
N	35	12	44	31
No. hindwing ocelli				
Mean \pm SD	5.5 \pm 0.6	5.75 \pm 0.4	5.5 \pm 0.55	5.9 \pm 0.45
Range	4–6	5–6	5–6	5–6
N	35	12	44	31
3rd & 4th hindwing ocelli bifid				
%		2		
N		47		200
3rd & 4th ocelli set at oblique angle*				
%	74	100	18	20
N	35	12	100	100
Ocelli ring	Thin, not very contrasting with ground color		Thick, contrasting with ground color	
Ventral wing color	Not brightly contrasting with dorsal surface		Brightly contrasting with dorsal surface	
Medial transverse bands	More rufous than brown, thin, and contrasting with ground color (98% of sample)		Dark brown, contrasting less with ground color (90% of sample)	
N	200		47	
Voltinism	Bivoltine		Univoltine	
Habitat	Treed fen		Tamarack bog	

* Frequencies underlying percentages differ between subspecies for both males and females ($P < 0.01$, 2×2 contingency tables, adjusted G-test).

near inner margin. Distance between the two parallel bands is visually uniform width of 3.75 mm. Ventral forewing outer margin fringed as dorsally. Two submarginal rufous bands separated by light band of ground scales. Rufous bands of hindwing larger and more rufous than forewing.

Six postmedial hindwing ocelli arranged in curved pattern mirror contour of outer margin. Cells R_5 , M_1 , M_2 , M_3 , Cu_1 , Cu_2 have ocelli. Ocelli of cells R_5 , M_1 greatly reduced but retain silvered pupils. Ocelli in cells M_2 , M_3 largest, best developed. All ocelli ovoid and pointed distally. Third and 5th ocelli of cells M_2 , Cu_1 nearly bifid with double silvered pupils. Fourth ocelli in cell M_3 double-pupiled but not bifid. Each ocellus with a thin yellow buff circulus as in forewing. Ocelli of cells M_2 , M_3 set at oblique angle, pointing distally away from each other at 60° ; ocellus of M_2 pointing in anterior direction, ocellus of cell M_3 pointing in posterior direction.

Types. Holotype male, Fort Bragg, North Carolina, 21 August 1984, in U.S. National Museum, Washington, D.C.; 46 male and 13 female paratypes in collections of American

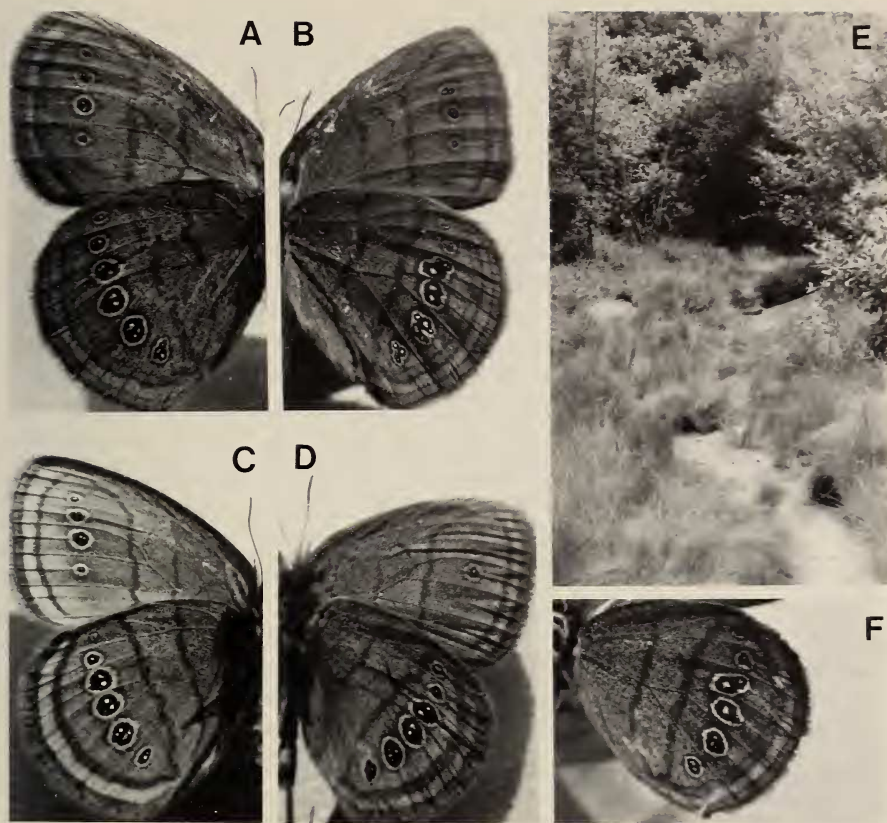


FIG. 2. *Neonympha mitchellii*. A, *N. m. francisci* female paratype, Fort Bragg, North Carolina, 31 August 1984. B, *N. m. francisci* holotype male. C, *N. m. mitchellii* female, Jackson Co., Michigan, 5 July 1984 leg. D. K. Parshall. D, *N. m. mitchellii* male, Springdale, New Jersey, 12 July 1970 leg. W. B. Wright Jr. E, *N. m. francisci* type locality. F, *N. m. francisci* paratype showing hindwing with oblique ocelli.

Museum of Natural History, New York; private collections of Thomas W. Kral, Richard Anderson of Gainesville, Florida, and David Parshall.

Etymology. We name the new subspecies in honor of Saint Francis of Assisi, known for kindness to animals and a love of natural beauty.

DISCUSSION

Paratype males differ little from the holotype male. Female paratypes are larger and more variable than male paratypes, with ventral ground color lighter in females (Table 1).

Subspecies *francisci* differs from the nominate in several ways (Table 1). Dorsal surfaces contrast less with ventral in *francisci* males and females; sexual dimorphism in number of forewing ocelli is less pro-

nounced in *francisci*; *francisci* females are darker ventrally, with less round ocelli distally more pointed; the yellow ring of ocelli is thinner and contrasts less with ground color; third and fourth ventral hindwing ocelli are occasionally (2%) bifid; and ventral forewing and hindwing transverse bands are more rufous and contrast more with ground color.

The habitat of *N. m. francisci* is quite different from that of nominate *mitchellii* (Fig. 2). McAlpine (1936) described the nominate type locality in Cass Co., Michigan, as grassy glades along streams running through a tamarack bog. Pallister (1927) and Rutkowski (1966) gave much the same description for Ohio and New Jersey habitats.

The North Carolina habitat is a treed fenlike area surrounded on three sides by thickly forested sandhills. The colony occurs along an apparently spring-fed stream where succulent growth of sedges and grasses has developed in openings of a few meters. The surrounding sandhill forest is composed mainly of *Magnolia grandiflora* L., *M. virginiana* L., *Sassafras albidum* (Nutt.) Nees, *Carya cordiformis* (Wangenh.) K. Koch, and *Pinus taeda* L., with an understory of fern and *Arundinaria tecta* (Walt.) Muhl., *Vaccinium coymbosum* L., and with thick alder often choking the water course.

Only a few butterfly species are on the wing in this habitat at the same time as *Neonympha m. francisci*. The most notable is *N. areolatus* which begins flight at the end of the flight of *N. m. francisci* and, like the latter, is bivoltine. Flight dates for *N. m. francisci* are 5 May to 6 June, and 26 July to 21 August. Flight dates for *N. areolatus* at Fort Bragg are 30 May to 28 June, and 15 August to 8 September (1983–86).

Subspecies *francisci* is isolated from all known nominate *mitchellii* populations. The North Carolina population is bivoltine; all nominate populations are univoltine, peaking around the first week in July. Isolation of the North Carolina population may represent a preglacial distribution and adaptation, or a post-Wisconsin isolation and adaptation. Other colonies may exist south of North Carolina, and might yield evidence to support a southern preglacial origin of *mitchellii*.

The North Carolina population of *mitchellii* is small, with less than 100 adults produced per season, but seems secure for the short term because of its isolation on Fort Bragg away from the public. The Ohio population is likely extinct (Shuey et al. 1987), and the small New Jersey population's status is unclear. In Indiana, the known range is greatly restricted but may be somewhat protected because it still occurs in a few State parks and preserves (Shull 1987). In 1987, Michigan placed *N. mitchellii* on the State list of threatened and endangered species, making the collection of *mitchellii* unlawful without a permit (Michigan Public Act 203 of 1974 rules as amended effective 4 Sept. 1987). While

this gives the species some protection in Michigan for the short term, it limits study of the insect to those who seek a permit, and does not protect its habitat for the long term.

There is not a more endangered butterfly population in the eastern U.S. than *N. m. francisci*. Because of its small population and uncertain future over the long term on military lands, this butterfly will need conservation. We hope in naming this unique population that more field research will be generated, and that this attention will lead to real protection of not only the colony at Fort Bragg but colonies elsewhere as well.

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